REMARKS

Claims 1-4 are pending. Claims 1 and 4 are herein amended.

Specification Objection

The specification was objected to because it has terms which are not clear, concise and exact, and that the specification should be revised to comply with 35 U.S.C. 112, first paragraph. Specifically, the sentence starting on page 1 and continuing on page 2 was objected to for being unclear. That sentence has been amended. In addition, in the paragraph starting at page 5, line 20, the term "volumetric content" has been changed to "volume fraction." Withdrawal of the objection is now requested.

Claim Rejections Under 35 U.S.C. § 112

Claim 4 was rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. The Examiner states that the term "volumetric content" is a relative term which renders the claim indefinite. In claim 4, the term "volumetric content" has been changed to "volume fraction" and the claim has been amended to set forth a total unit of measurement for which the volume fraction is based upon. Withdrawal of the rejection is now requested.

Claim Rejections based on *Ranta*

Claims 1 and 3 were rejected under 35 U.S.C. § 102(a) as being anticipated by ***Ranta*** (Carbon Nanotube Reinforcement of a Filament Winding Resin, disclosed in the IDS filed August 20, 2003); and claims 1-4 were rejected under 35 U.S.C. 103(a) as being unpatentable over *Ranta* as applied to Claims 1 and 3 and in view of the Examiner's Remarks. Favorable reconsideration of the rejection is now requested.

The present invention is characterized in that the compressive strength of the composite is remarkably enhanced as shown in the embodiments in the specification (see Figs.2-3), which Applicants understand was impossible for conventional carbon nanofiber-dispersed resin fiber-reinforced composite materials.

Fig. 3 shows the results of testing the compressive strength of specimens of the present invention compared to specimens of conventional composite materials. The vertical axis of Fig. 3 shows the specific compressive strength of the specimens. Specimens I to III represent embodiments I to III of the present invention. Specimens I to III were made from the carbon nanofiber-dispersed resin fiber-reinforced composite material of the present invention (fiber reinforcement having 10 layered structures) by cutting a section having a length of 52 mm, a mean width of 11.5 mm, and mean thickness of 2.05 mm. The specimens were compressed by a compressive machine. Specimens IV and V are comparative examples. Specimen IV is the metal AL7075T6 and specimen V is the metal SSPH15-7Mo.

The results of the test show that the carbon nanofiber-dispersed resin fiber-reinforced composite material of embodiments I to III had a 44% to 77% higher specific compressed strength compared to the comparative examples (IV and V).

Furthermore, when commercially available multi-walled carbon nanotubes (MWNTs) were used instead of the carbon nanofiber-dispersed resin fiber-reinforced composite material of the present invention, the test could not be continued. No test data was obtained from a conventional carbon nanofiber-dispersed resin fiber-reinforced composite material where carbon nanofibers were <u>layered concentrically</u>. No test data could be obtained because the carbon

nanofibers were not well dispersed throughout the epoxy resin which formed large agglomerates and did not achieve uniform dispersion of the carbon nanofibers. Consequently, the fiber-reinforced composite material could not be well impregnated in the matrix.

The reason why the compressive strength increased more in the carbon nanofiber-dispersed resin fiber-reinforced composite material of the present invention is thought to be because the carbon nanofiber has a characteristic structure in which the cup-shaped carbon net layers are sequentially stacked one on top of the other and have dispersion throughout the resin. In addition, the wettability and the impregnating nature of the carbon fibers are superior to those of the multi-walled nanotubes having a structure where the carbon nanofibers are merely concentrically layered.

More specifically, Applicants understand "the carbon nanofibers having a structure in which the cup-shaped carbon net layers are sequentially stacked one on top of the other" applied to the present invention provides good intimate contact with the resin at the outer circumference of the carbon nanofibers in which cup-shaped rims stack sequentially. They also increase mechanical friction with the resin and the dispersion in the resin is well precipitated. The carbon nanofibers are uniformly dispersed in the fiber reinforcement and the wettability between the carbon nanofibers and fiber reinforcement is also precipitated. The carbon nanofibers enhance the interlayer binding so that the strength of the delamination is enhanced and at same time the compressive strength is also enhanced. (Specification, page 10, line 26 to page 11, line 11.)

On the other hand, *Ranta* discloses that single walled nanotubes (SWNTs) are dispersed in epoxy using an intermediate solution of acetone and surfactant along with high power

ultrasound. This nanotube-impregnated epoxy is used to filament wind with Toray T-700SC-12K carbon fiber.

Applicants respectfully submit that *Ranta* does not disclose "wherein the carbon nanofibers have a structure in which cup-shaped carbon net layers are sequentially stacked one on top of the other" as recited in amended claim 1.

In *Ranta*, only two types of carbon nanotubes are disclosed. One is single walled nanotubes (SWNTs) consisting of a single concentric tube and the other is multi-walled nanotubes (MWNTs) consisting of multiple concentric tubes. However, *Ranta* contains no disclosure of the carbon nanofibers having a structure in which the cup-shaped carbon net layers are sequentially stacked one on top of the other.

Moreover, tests of the filament wound nanotube disclosed in *Ranta* showed no effect on the compressive strength of the composite. *Ranta* discloses single walled carbon nanotubes dispersed in epoxy and this nanotube-impregnated epoxy is used to filament wind with the carbon fiber. The filament wound composite specimens were tested in longitudinal compression. (*Ranta*, page 1777.) The results of the test were that the nanotubes "had no discernible effect on the compressive strength of the composite." (*Ranta*, page 1781, § 3.2 "Results from the Composite Specimens"; Table 3.) This demonstrates a problem that *Ranta* could not solve. However, the present invention does in fact solve this problem.

Ranta does not disclose carbon nanofibers having a structure in which cup-shaped net layers are sequentially stacked on top of the other. Therefore, *Ranta* does not disclose the elements as recited in claim 1.

Accordingly, withdrawal of the § 102 rejection of claims 1 and 3, and the § 103 rejection of claims 1-4 is hereby solicited.

In view of the aforementioned amendments and accompanying remarks, Applicants submit that that the claims, as herein amended, are in condition for allowance. Applicants request such action at an early date.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney to arrange for an interview to expedite the disposition of this case.

If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP

Stephen G. Adrian
Attorney for Applicants
Registration No. 32,878
Telephone: (202) 822-1100
Facsimile: (202) 822-1111

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